MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.59218/makrjms.2023.9.27.33

Study of Functional Outcome of Lisfranc Fracture Dislocation in Sir T Hospital Bhavnagar: A Prospective Observational Study

[1]Chirag Kalathiya, [2]Vishal Mehta, [3]Vrushik Kothiya and [4]Suresh Parmar

[1-4]Department of Orthopedics, Government Medical College, Bhavnagar, Gujarat, India

OPEN ACCESS

Key Words
AOFAS SCORE, k-wire, trans articular screw fixation, lisfranc joint fracture

Corresponding Author
Suresh Parmar,
Department of Orthopaedics, Government Medical College, Bhavnagar, Gujarat, India
drsureshparmar123@gmail.com

Author Designation
[1]Senior Resident
[2,4]Associate Professor
[3]Junior Resident

Received: 16 August 2023
Accepted: 4 September 2023
Published: 5 September 2023

Citation: Chirag Kalathiya, Vishal Mehta, Vrushik Kothiya and Suresh Parmar, 2023. Study of Functional Outcome of Lisfranc Fracture Dislocation in Sir T Hospital Bhavnagar: A Prospective Observational Study. Res. J. Med. Sci., 17: 27-33, doi:

ABSTRACT

The term "Lisfranc injury" encompasses a wide range of injuries involving displacement of one or more metatarsals in relation to the tarsus. These injuries can vary from low-energy sports-related incidents to high-energy trauma and may involve ligamentous damage or fractures of metatarsals, cuneiform, or cuboid bones. Early and accurate diagnosis is crucial for proper treatment and preventing long-term complications. Timely anatomical reduction and stable internal fixation are key to achieving optimal outcomes. This study aimed to assess the functional outcomes of Lisfranc injuries treated with open reduction and internal fixation using trans articular screw fixation. The evaluation was conducted with a minimum follow-up period of 6 months, utilizing the AOFAS midfoot score. This prospective observational study took place at the Department of Orthopaedics, Government Medical College, Bhavnagar, Gujarat, India from July 2021 to September 2022. A total of 30 consecutive patients aged 18-60 who underwent surgical fixation for Lisfranc injuries using trans articular screw fixation were followed up. Functional outcomes were assessed by AOFAS midfoot score after the procedure. Most patients fell within the 18-30 age group, with a mean age of 36.65. Of the participants, 18 (60%) were male and 12 (40%) were female. Road traffic accidents (RTA) accounted for 16 cases (53%) as the primary mode of injury, while 10 (33%) resulted from falls from height and 4 (14%) from sports injuries. The AOFAS midfoot score was excellent in 10 (33%) patient. Trans articular screw fixation for Lisfranc fractures resulted in excellent functional outcomes. The study supports the importance of achieving stable anatomical reduction in Lisfranc joint fracture-dislocations for favorable long-term results. Severe fracture dislocations often require open reduction with screws or K-wires, with initial reduction quality impacting results.

INTRODUCTION

A Lisfranc injury is named after Jacques Lisfranc de St. Martin, a French surgeon and gynaecologist who served in Napoleon's army during the Napoleonic wars[1]. He first described this injury when a soldier's foot got caught in a stirrup while falling from a horse, resulting in amputation at the tarsometatarsal (TMT) joint due to a vascular injury. Lisfranc injury refers to damage to the TMT joint complex or midfoot[1]. This injury can involve the displacement of one or more metatarsal bones from the tarsal bones. It may manifest as ligamentous, bony, or a combination of both types of damage. The Lisfranc ligament connects the medial cuneiform bone to the base of the second metatarsal and injuries can range from nondisplaced to fracture-dislocations affecting some or all of the TMT joints[1].

Injuries to the TMT joint complex are rare, occurring in roughly 1 out of 55,000 people annually and they make up only 0.1-0.4% of all fractures[2]. It's worth noting that nearly 20% of these injuries are initially missed on X-rays. The increasing recognition of Lisfranc injuries in modern medicine is due in part to improved diagnostic imaging techniques, particularly CT and MRI scans[2,3]. Lisfranc injuries are uncommon, making up only about 0.2% of all fractures and often go unnoticed or are diagnosed late, with roughly 20% initially missed[4]. These injuries can result from low-energy events in sports like rugby, football and ice hockey or high-energy incidents such as motor vehicle accidents, falls from heights and crush injuries. They typically involve a direct blow or axial loading on metatarsal bones with rotational forces, leading to ligament damage and fractures[4]. The Lisfranc joint injury pattern is notorious for its propensity to lead to secondary arthritis when left untreated or when managed with incongruent methods[5].

Early diagnosis and prompt management of Lisfranc injuries are imperative, given their potential to reduce the incidence of secondary degenerative arthritis, chronic instability, pain and disability[6]. This study aims to progress from conservative approaches to internal fixation in fractures as a viable treatment modality. Nonetheless, Lisfranc fractures remain a formidable challenge due to their multiplicity, diversity and intricacy.

MATERIALS AND METHODOLOGY

This prospective observational study involved 30 patients, conducted with approval from the Ethics Committee of Government Medical College, Bhavnagar, Gujarat, India. The patients were admitted to the orthopaedics department between July 1, 2021 and September 30, 2022, based on specific inclusion and exclusion criteria. Written and informed consent were obtained from all participants.

The sample size was determined using the effect sizes observed in a previously published study by Sieh in 2003, along with the following equation:

$$n = \frac{4pq}{l^2}$$

Where:

p = 0.80 (Approximate incidence of a good/ excellent prognosis after the operative procedure)

q = 0.20 (Approximate incidence of a poor/ reasonable prognosis after the operative procedure) me = 0.15 (margin of error)

Calculating:

$$n = \frac{4 \times 0.80 \times 0.20}{(0.15)\ 2 = 28.4}$$

As the equation yielded a minimum required sample size of 28.4, a total of 30 participants were included in the study.

Inclusion criteria encompassed individuals aged 18 years and older, with injuries sustained within two weeks, closed fractures and unilateral Lisfranc fractures. Exclusion criteria included individuals aged over 60 or under 18, severe medical comorbid conditions, local skin diseases, pre-existing foot deformities, pathological fractures, crush injuries to the foot, polytrauma and bilateral Lisfranc fractures.

A comprehensive patient history was systematically collected, encompassing details such as age, gender, anthropometric measurements (height and weight), occupation, education and activity level. Additionally, the history included a thorough account of the mode of injury, onset and duration of symptoms, as well as any prior treatments received. The physical examination consisted of both a general physical and systemic assessment, along with a detailed examination of the affected foot and ankle. An evaluation for any concurrent foot injuries was also conducted. Ankle range of motion was quantified and compared to the unaffected side, with the results duly documented.

Radiographic imaging, including anteroposterior, lateral and oblique views of the affected foot, was obtained. Routine pre-operative investigations were performed in accordance with established protocols, encompassing chest radiographs, electrocardiography

Fig. 1: Reduction technique

Method of reducti on, traction and manipulation

Toes traction

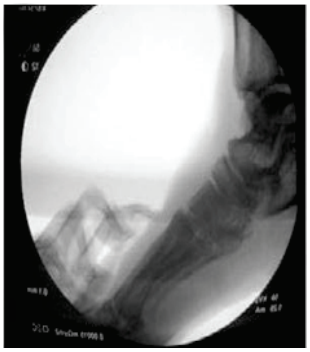
Forefoot traction

Forefoot manipulation

Direct pressure

Image view shows displaced 2nd metatarsal

Operative picture showing direct pressure over displaced metatarsal



Reduced 2nd metatarsal by direct pressure

Bone clamp

Operative picture showing a bone clamp applied to reduce displaced 1st web

Image view of displaced 1st web

Reduced 1st web using reduction bone clamp

(ECG), complete blood counts, kidney function tests and screening for HBsAg, HCV and HIV. A pre-anesthetic examination was conducted before surgery and informed consent was obtained from each patient, accompanied by a comprehensive explanation of the procedure and its potential complications. Upon induction of anesthesia, patients received intravenous antibiotics for prophylactic purposes. Spinal anesthesia was administered to all patients, with a few exceptions where general anesthesia was preferred. Subsequently, patients were positioned supine on the operating table, with a cushion placed beneath the ipsilateral knee joint and a tourniquet was secured at a high position on the thigh. The surgical site was aseptically prepared, including draping in accordance with established sterile techniques. The tourniquet was inflated following limb exsanguination through the use of a sterile Esmarch bandage. Subsequent surgical procedures were conducted in a systematic and stepwise manner (Fig. 1-3).

Surgical approach

Dorsal medial longitudinal approach:

- **Skin Incision:** The initial step involves making a skin incision aligned with the first ray, commencing at the medial cuneiform and extending toward the dorsolateral region of the first metatarsal phalangeal joint. Following the skin incision, subcutaneous dissection was performed

Fig. 2(a-e): Medial and lateral longitudinal incision (a) Medica skin incision mark, (b) Lateral skin incision mark, (c) Superficial medical incision, (d) Deep incision and (e) Identify Dislocation of TMT joint

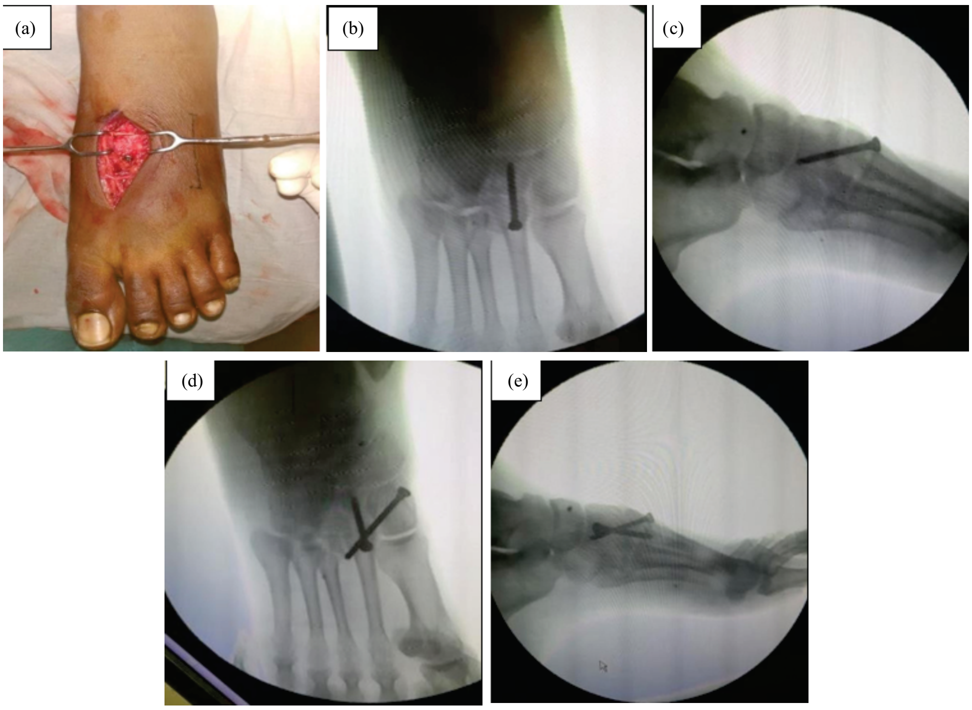


Fig. 3(a-e): Medial column fixation (a) Clinical Image, (b) IITV shot AP view, (c) IITV shot lateral view, (d) IITV shot AP view and (e) IITV shot lateral view

- **Deep dissection:** The subsequent stage involves exposing the first metatarsal by carefully dissecting between the tendons of the extensor hallucis longus (EHL) and extensor hallucis brevis (EHB). A full-thickness flap is created to safeguard the neurovascular bundle. The EHL tendon is retracted medially, while the neurovascular bundle is gently retracted laterally to expose both the tarsometatarsal joint and the intercuneiform joint. Particular attention is given to preserving the integrity of the dorsalis pedis artery and the cutaneous branches of the deep peroneal nerve.

Lateral longitudinal incision:

- **Skin incision:** An incision is carefully made along the lateral border of the third tarsometatarsal (TMT) joint, extending proximally to the shaft of the third metatarsal. Subsequent to the skin incision, subcutaneous dissection is conducted to expose the TMT joint, allowing for the identification of the extensor retinaculum
- **Deep dissection:** The deep dissection procedure involves the exposure of the extensor digitorum communis (EDC) tendon and the medial margin of the extensor digitorum brevis (EDB) muscle. A full-thickness flap is created, facilitating subperiosteal dissection in a medial direction, toward the lateral aspect of the second TMT joint. In cases where necessary, this dissection is extended laterally to encompass the fourth and fifth joints.
- **Position of the patient:** The position of the patient was supine with a leg on a bolster and painting done with betadine solution.

Operative steps: The surgical approach for addressing the first and second tarsometatarsal (TMT) joints involves a single dorsal incision positioned over the first intermetatarsal space. Care is taken to preserve the branches of the superficial and deep peroneal nerves, as well as the dorsalis pedis artery. Subsequently, the first and second metatarsocuneiform joints are opened and irrigated.

In the presence of comminute fragments, reduction is attempted whenever feasible, smaller, irreducible fragments are excised. The alignment of the first TMT joint is achieved by reducing the medial border of the medial cuneiform to align with the medial border of the first metatarsal. Direct visualization of the plantar-medial aspect of the joint is performed to ensure the absence of any plantar gap. The joint is provisionally reduced using a Kirschner wire, followed by the insertion of a 3.5 mm trans articular countersunk cortical set screw from the metatarsal base proximally into the medial cuneiform. Care is exercised to avoid impinging on the adjacent naviculocuneiform joint. If instability persists, an additional 3.5 mm screw can be placed in a proximal-to-distal and lateral-to-medial orientation to enhance rotational stability.

Fig. 4(a-e): Lateral Column Fixation (a) Clinical image, (b) IITV shot AP view, (c) Clinical image, (d) IITV shot AP view and (e) Clinical image of skin suture

Subsequently, the second metatarsal is reduced to align with the medial border of the middle cuneiform and provisionally secured using a Kirschner wire. A 3.5 mm countersunk cortical screw is inserted from a distal to the proximal direction across the joint. To augment fixation stability, an additional 3.5 mm countersunk cortical set screw, commonly referred to as the Lisfranc screw, is inserted under biplanar fluoroscopy from the medial cuneiform into the base of the second metatarsal. This Lisfranc screw is ideally positioned along the trajectory of the interosseous Lisfranc ligament.

In cases where the third metatarsal base is dislocated, a second dorsal incision is performed between the third and fourth metatarsals to access the third metatarsocuneiform joint. Reduction is accomplished and stabilization is achieved through the placement of a countersunk 3.5 mm screw from distal to proximal.

Typically, the fourth and fifth tarsometatarsal joints reduce spontaneously once the preceding reductions are achieved. These joints are held in place using one or two trans articular percutaneous smooth (non-threaded) Kirschner wires, extending from the base of the fifth metatarsal into the cuboid. Open reduction of these lateral two joints is rarely necessary. The alignment of fractures and tarsometatarsal joints, as well as the positioning of implants, is meticulously assessed through fluoroscopy and intra-operative radiographs.

Patient follow-up was conducted employing a validated assessment tool, the 'AOFAS Midfoot Score,' which is endorsed by the American orthopaedic foot and ankle society (AOFAS). This scoring system is rooted in various parameters, including the assessment of pain, deformity, surgical site integrity, range of motion of the ankle and foot, ambulatory capability with or without external support and radiographic evaluation encompassing union status, implant integrity and the presence of osteoarthritis. Attaining an AOFAS score equal to or greater than 60 out of 100 signifies a favorable functional outcome.

Data pertinent to the study were meticulously collected through a combination of patient case records, individual interviews and comprehensive clinical examinations. The amassed data were then meticulously entered into an Excel spreadsheet for subsequent analysis. Categorical variables were presented as proportions, while quantitative variables were summarized as mean values along with their corresponding standard deviations. Statistical analysis of the data was carried out using GraphPad Version 7.0, a specialized statistical software.

RESULTS

The present study included a cohort of 30 patients, with ages ranging from 18-60 years (Table 1). Of these, 10 patients underwent treatment via Open Reduction and Internal Fixation (ORIF) employing 3.5mm cortical screws exclusively, while 6 patients were subjected to ORIF with plating. Additionally, 14 patients were managed using Kirschner wire fixation (Table 2). To evaluate functional outcomes, the American Foot and Ankle Society Score (AOFAS) was employed, with categorization into Excellent (90-100), Good (80-89), Fair (70-79) and Poor (<70) score ranges.

The mean AOFAS score observed in this study was 85.2, with 33% (n = 10) of patients achieving an Excellent score and 53% (n = 16) attaining a Good score. A Fair score was observed in 11% (n = 3) of patients, while a Poor score was noted in only 3% (n = 1) of cases (Table 3). Posttraumatic arthritis was found to be more prevalent among patients who did not achieve an anatomical reduction.

Furthermore, superficial skin infections were reported in 1 patient who underwent treatment with ORIF using screws, 1 patient subjected to ORIF with a plate and 1 patient treated with Kirschner wire fixation. Additionally, the latter patient also exhibited a pin-track infection. All infected patients received antibiotic treatment tailored to the results of culture and sensitivity testing (Table 2).

Table 1: Demographic and clinical characteristics of patients

Parameters	No.	Percentage
Age groups		
18-30	12	40.0
30-40	10	33.3
40-50	5	16.7
50-60	3	10.0
Gender		
Male	18	60.0
Female	12	40.0
Injury side		
Left	13	44.0
Right	17	56.0
Mode of injury		
Road traffic accident	16	53.0
Fall from height	10	33.0
Sport-related injuries	4	14.0

Table 2: Operative characteristics

Parameters	No.	Percentage
Procedure		
ORIF With 3.5 mm cortical screws	10	34
k-wire fixation	14	46
ORIF with platting	6	20
Complications		
None	24	80
Delayed union of malunion	0	0
Implant failure	0	0
Secondary osteoarthritis	3	10
Infection	3	10

Table 3: Functional outcome final follows up at 6-month AOFAS SCORE

AOFAS score	Frequency	Percentage
Excellent	10	33
Good	16	53
Fair	3	11
Poor	1	3

DISCUSSIONS

The study encompassed a cohort of 30 patients, whose ages spanned from 18-60 years. The mean age for male participants was 33 years, while female participants exhibited a mean age of 42 years. The overall mean age for the entire study population was 36.65 years, with a gender distribution of 60% male and 40% female.

Comparatively, Ritcher *et al*.[7] reported a cohort of 93 patients with a mean age of 28 years, comprising 68% male and 32% female individuals. Kuo *et al*.[8] conducted a study involving 48 patients with a mean age of 49 years, with 66% male and 34% female representation. Abdelgaid *et al*.[4] examined 37 patients with a mean age of 36.5 years, demonstrating a distribution of 56% male and 44% female participants. Lastly, Rammelt *et al*.[9] investigated 22 patients with a mean age of 35 years, comprising 77% male and 23% female individuals.

In the present study mode of injury is Road traffic accidents most common and accidental fall from height second most common, sport-related injury. Right side foot injury 56% (17 patients) more than compared to left side foot injury 44% (13 patients). Abdelgaid *et al*.[4], Ritcher *et al*.[7], Kuo *et al*.[8] and Rammelt *et al*.[8] found road traffic accident was the major cause of the mode of injury. Our study was concordant with Ritcher *et al*.[7], Abdelgaid[4] and Rammelt *et al*.[8] with majority having right side foot injury while different from the Kuo et al. having majority of left side foot injury.

In the study conducted by Ritcher *et al*.[7] 73% of participants achieved a Good to Excellent outcome, while 16% had Fair results and 10.8% experienced a Poor outcome, with an average AOFAS Midfoot Score of 72.0. Notably, post-traumatic arthritis was observed in 38% of cases. Similarly, in the research by Kuo *et al*.[8] 62% of individuals attained a Good to Excellent outcome, 16.6% had Fair results and 20% had Poor results. The average AOFAS Midfoot Score was 80.2 and post-traumatic arthritis was noted in 25% of cases. Abdelgaid[4] study showed that 86.4% of individuals had a Good to Excellent outcome, 8% achieved Fair results and 5.4% experienced a Poor outcome, with an average AOFAS Midfoot Score of 87.0. Post-traumatic arthritis was observed in 8% of cases. In Rammelt *et al*.[9] research, 68% of participants attained a Good to Excellent result, 36% had Fair results and 10% had Poor results, with an average AOFAS Midfoot Score of 81.4. However, post-traumatic arthritis data were not available (NA) for this study. Finally, in our study, 86% of participants achieved a Good to Excellent outcome, 11% had Fair results and 3% had Poor results, with an average AOFAS Midfoot Score of 85.2. Post-traumatic arthritis was noted in 10% of cases.

CONCLUSION

Precise anatomical reduction is crucial for better clinical and radiological outcomes, while non-anatomical reduction can lead to chronic disability and post-traumatic arthritis. Trans-articular screw fixation provides stability, avoiding the need for footwear modifications by restoring the foot's arch. Diagnosing and treating Lisfranc injuries are challenging and affect long-term function. Distinguishing Lisfranc injuries in athletes from fractures is important, as treatment approaches differ. Severe fracture dislocations often require open reduction with screws or K-wires, with initial reduction quality impacting results. Prompt diagnosis and treatment are vital for athletes to return to play, as delayed treatment can lead to painful disability and increased costs. Primary arthrodesis is increasingly preferred, given the risks associated with K-wire fixation. Larger sample sizes are needed for comprehensive Lisfranc injury research and the AOFAS score is a valuable assessment tool.

REFERENCES

1. Eleftheriou, K.I., P.F. Rosenfeld and J.D.F. Calder, 2013. Lisfranc injuries: An update. Knee. Surg. Sports. Traumatol, Arthrosc., 21: 1434-1446.
2. Kapoor, C., A. Patel, M. Jhaveri and P. Golwala, 2016. Post-traumatic arthritis of the tarsometatarsal joint complex: A case report. Cureus, Vol. 8. 10.7759/cureus.923
3. Moracia-Ochagavía, I. and E.C. Rodríguez-Merchán, 2019. Lisfranc fracture-dislocations: Current management. EFORT. Open Rev., 4: 430-444.
4. Abdelgaid, S.M., 2013. Closed reduction and percutaneous fixation of lisfranc joints injuries: Possibility, technique and results. Clin. Res. Foot. Ankle, Vol. 1. 10.4172/2329-910x.1000109
5. Dharmshaktu, G.S., 2015. Neglected lisfranc's joint injury: A case report and literature review. Indian J. Orthop. Surg., 1: 183-185.
6. Stavrakakis, I.M., G.E. Magarakis and Z. Christoforakis, 2019. Percutaneous fixation of lisfranc joint injuries: A systematic review of the literature. Acta. Orthop. Traumatol. Turcica., 53: 457-462.
7. Richter, M., H. Thermann, T. Huefner, U. Schmidt and C. Krettek, 2002. Aetiology, treatment and dislocations and fracture outcome in lisfranc joint dislocations. Foot. ankle. surg., 8: 21-23.
8. Kuo, R.S., N.C. Tejwani, C.W. Digiovanni, S.K. Holt, S.K. Benirschke, S.T. Hansen Jr and B.J. Sangeorzan, 2000. Outcome after open reduction and internal fixation of lisfranc joint injuries. J. Bone Joint Surg. Am., 82: 1609-1618.
9. Rammelt, S., W. Schneiders, H. Schikore, M. Holch, J. Heineck and H. Zwipp, 2008. Primary open reduction and fixation compared with delayed corrective arthrodesis in the treatment of tarsometatarsal (Lisfranc) fracture dislocation. J. Bone. Joint. Surg. Br., 90: 1499-1506.